Centralized Monitoring System For Street Light Fault Detection and Location tracking

Nalubolu Geetha Rani[1], N.Praveen Kumar[2], Madhusudhana Reddy Barusu[1], D Venkata Srihari Babu[3], Supraja.V[4]

[1]Department of ECE, Ravindra College of Engineering for Women, Kurnool, India
[2]Department of ECE, Santhiram Engineering College, Nandyal , India
[3]Department of ECE, G. Pulla Reddy Engineering College, Kurnool, India
[4]Department of ECE, G. Pullaiah College of Engineering and Technology, Kurnool, India

***Abstract*-Wireless communication is a technology that focuses on the connection between devices or devices and between people. Now many of these connections have changed from "people" to "tools." It has become important to use this technology to detect illegal lighting. The main purpose of the project is to control and detect lighting damages. The lighting system aims to provide real-time information about lighting conditions by operating automatically on the road using cheap electricity. As always, the degradation of light is due to complaints from people in the community (street). And in this working plan, the operating conditions of these lights can be easily detected using sensors without the need for any interaction. This reduces the cost of manual work and delays problem solving. Therefore, in order to reduce such problems, we see the problems in street lighting and produce solutions, for example; It should be checked whether street lights are working at night, and if there is a problem with special lighting, authorized personnel should be notified. The location of the broken road should be reported. The LDR sensor will automatically turn the street lighting on and off according to the weather.**

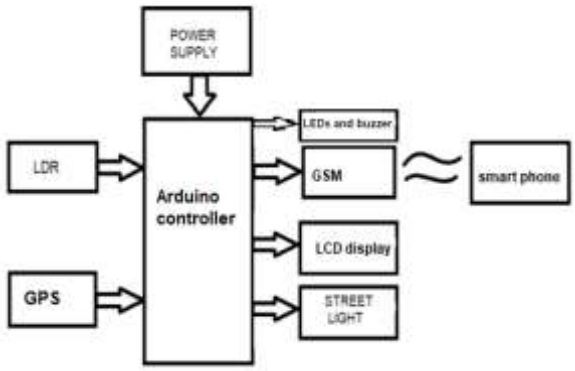
Key Words- Arduino nano, GPS neo 6M, GSM SIM800C, LDR, LED, LCD screen, Embedded C, Arduino IDE

I. INTRODUCTION

The Internet of Things plays an important and insignificant role in daily life. There are changes proposed to improve the life of the traditional system and other aspects of the family. The main problem with existing electricity is the connection problem, as main connections are manually managed by many contractors[1]. Set the timer manually. Additionally, the timer needs continuous power for 12 hours and the timer may be interrupted during a power outage. Wireless technology is characterized by pervasive sharing, the importance of the world of small objects, and the ability to process and store, including representation, privacy, consistency, and security. By connecting all devices wirelessly, multiple networks can easily maintain and efficiently configure all applications anytime, anywhere[2]. Internet systems combine IT (information technology) and OT (operational technology) to learn and improve information generated by machines. Based on the research work of Li Dazu and others. D. Giusto et al. and Saifuzaman et al. Wireless uses the Internet to combine physical devices with sensors, electronics, and software, allowing objects to receive and exchange information from the ecosystem. All the products described here are defined as wireless because they are used to create a better environment [3]. As we all know, one of the important assets of cities is lighting, which ensures road safety and ensures the safety of urban areas and buildings. Wireless has many automation applications such as smart street, Smart Park, lighting and smart home. There are many problems in the current lighting guide, such as blocking problems, maintenance problems, timing problems. These problems can be solved with wireless technology [4]. The system relies on street lighting and climate change to maintain control. In business and daily life, automation has alleviated some problems. Street lighting works now face serious problems. Managing a remote location is very difficult. Human error can waste energy and reduce performance.

According to S.'s research. K. Cho et al. determined that lighting consumes 30% of electricity in every city. Now the lights turn on before sunset, turn off when there is light in the air, and sometimes they are on all day. Energy saving is our responsibility, so we must have energy saving protection[5]. Our project offers the best solution to energy waste. Automatic light on/off is a great solution that can reduce energy consumption by up to 20% when there is light in the environment.

Block diagram:



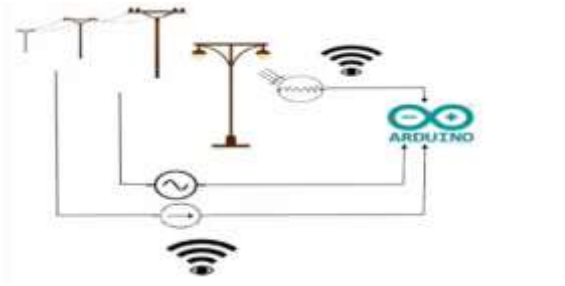


Fig.1. Block diagram of street light fault detection

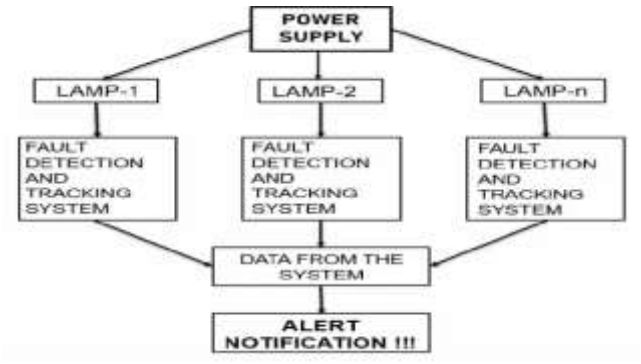


Fig.2.Flow chart diagram

II. WORKING PROCESS

According to today's lifestyle, energy is the country's development and reliable need. For better understanding, we created a street lighting model to demonstrate the effectiveness of our system[6]. This research project includes all reviews from different sources regarding different aspects of street lighting and the risks of human experiments. In this study, we discuss two important issues and get good results[7]. Adding other systems that will work well in the lighting process will help us make simple, lean and cost-effective learning accessible over the internet. LED driving architecture is ubiquitous and intelligently designed to ensure street lighting reliability and reduce energy waste. They undoubtedly describe the light on/off cut. The system will be able to control poor lighting, track the location of maintenance workers[8], and check whether maintenance workers have gone to the wrong place.

III. EXISTING CHALLENGES IN STREET LIGHT MAINTENANCE

- Lack of centralized monitoring
- Citizens complain about errors
- Inspection and testing error control
- Long-term maintenance

IV. PROPOSED SYSTEM

- This work plan is designed to develop a basic lighting system using Arduino nano, GSM, LDR, GPS and power adapter. While examining the harms of light, we will analyze the reduction in energy consumption [9]. This article introduces automatic lighting control and fault detection with cloud storage, which can control the turning on and off of street lights depending on the environment. user for permission. A person's mobile phone number. Thanks to the cloud storage system, we can monitor the system anytime and anywhere[10]. This system is very useful for companies in the city. In the future, we will detect sensor failure and power outage in the system and control optical power management according to the environment.
- Real-time fault detection, determination of the exact type of fault
- Accurate location tracking of illegal lights
- Motherboard central monitoring system ➡ GPS-enabled location tracking
- Automatic reporting and warning
- A centralized monitoring system for street lighting and location tracking could have great impact and future potential.

V. LITERATURE SURVEY

- B. K. Subraanyam1 et al. [11] is dedicated to an intelligent wireless lighting control and monitoring system that combines the latest technology, easy to control and energy saving. Using LDR we can save electricity and energy by using the solar panel on the lamp post and monitor and control the lighting using a GUI application that displays street lighting or highway lighting.
- P. Nithya et al. [12], in their study on creating a wireless basis for energy-saving street lighting automation, proposed to control the lighting by sending information to a central location via ZigBee wireless communication. Using the planning process, maintenance can be planned easily and efficiently from a central station, resulting in additional savings.
- Srikanth M et al. [13] worked on a remote automatic illumination system based on ZigBee. This lighting control system helps save energy, detect faulty lights, shorten maintenance time and extend life.
- Anila Devi Y et al. [14] is working on a GSM-based remote control system for efficient operation of lighting systems using Zigbee devices and sensor networks. New smart street lighting uses wireless technology for monitoring and sensor networks for control. Among these, they used LED lighting, which uses less energy, is long-lasting, and receives renewable energy from solar panels.
- So young Hwang et al. [15], Remote monitoring based on ZigBee network. Use JMF to achieve real-time remote monitoring. JMF is Java's multimedia extension API.

VI. HARDWARE DESCRIPTION

6.1. Arduino Nano:

Arduino Nano is a 16-pin, microcontroller-based device that can be used for many purposes. It can be used for almost any project, from small projects to large projects. It can also be used to design and create new applications[16]. The Arduino board reads the input - light from the sensor, finger on the button or Twitter message - and converts it into output - start the motor, turn on the LED, broadcast the content of the message online

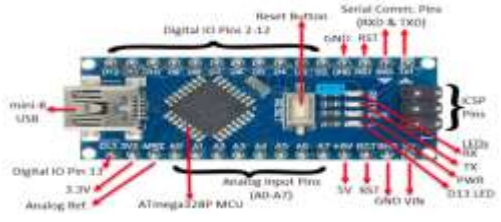


Fig. 3. Arduino nano pin out

Arduino is open source for electronic projects. Arduino consists of a physical programmable circuit board (often called a microcontroller) and a software or IDE (Integrated Development Environment) that runs on the computer and is used to write computer code and send it to the physical board.

6.2.LIGHT DEPENDENT RESISTOR (LDR)

- LDR or Light Dependent Resistor is particularly important in light/dark sensor circuits. Typically LDRs have very high resistance, sometimes up to 1,000,000 ohms, but when the resistance drops burned significantly. Electronic sensors are devices that change their electrical properties in the presence of visible or invisible light. Photo resistor, as the name suggests, changes in resistance depending on changes in light[17].
- LDR is made by depositing a thin film of cadmium sulfide or cadmium selenide on a ceramic substrate that has no or very few free electrons when not exposed to light[18]. The longer the strip, the higher the price.
- When light hits the metal strip, the resistance decreases. In the absence of light, the resistance is about 10 K ohms to 15 K ohms, this is called darkness resistance. Depending on the lighting the resistance will drop to 500 ohms. The power rating is usually small, such as 50 mw to 0.5 w. Although it is sensitive to light, it cannot be used in frequent applications because its conversion time is too long. They are used in chopper amplifiers. Photoresists are available in disks from 0.5 cm to 2.5 cm. In the dark, the resistance rises to several megaohms[19]. As shown in the figure below, when the flash is turned on, the resistance of the LDR drops, allowing current to flow as shown in the figure.

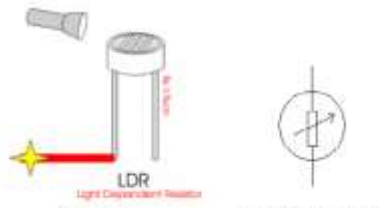


Fig.4 : LDR and Symbol for LDR

The basic structure and symbols of LDR are shown in the figure above. The device consists of a pair of metal films separated by a serpentine cadmium sulfide film, designed to provide maximum surface area between the two metal films. This model is housed in a clear plastic or resin case that provides access to outside light. Practical LDRs come in many sizes and package designs, with the largest having a surface diameter of approximately 10 mm. The performance LDR and diagram are shown in the figure below.

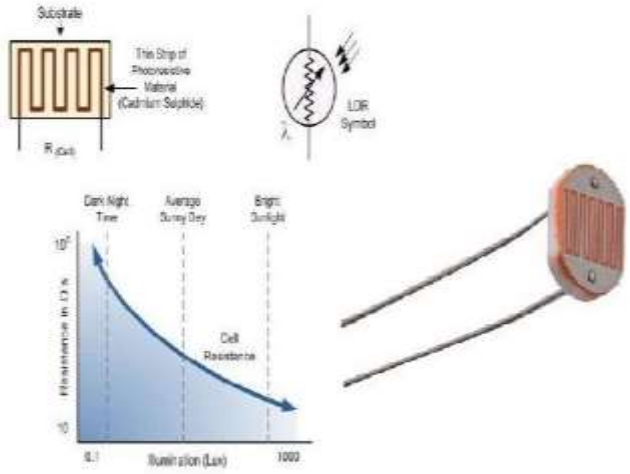


Fig.5: LDR and its characteristic graph

6.3. Liquid Crystal Display (LCD)

16 character x 2 line LCD module connected to the interface[20]. These LCD modules are very common today and very easy to use because all the logic has to run them on the board.

Fig.6. LCD with I2c Display

- 16x2 LCD green screen with IIC I2C serial interface adapter module, also known as panel or display screen, is an electronic device that displays information or images in the field of view. It has display technologies such as LCD (liquid crystal), OLED (organic light-emitting diode) or LED (light-emitting diode), as well as the necessary components for control and communication. Here are some important functions and features of the display module:

6.4. GSM SIM800L GPRS GSM module MicroSIM card core board with antenna quad-band serial port:

SIM800L GSM/GPRS module is a micro GSM modem that can be integrated into many IoT projects. You can use this model to do anything a regular phone can do; SMS messages, phone calls, GPRS, TCP/IP etc[21]. Connecting to the Internet via . inch. The chip operates at 3.4V to 4.4V, making it ideal for direct LiPo power consumption. This makes it a good choice to place in projects that don't need a lot of space.

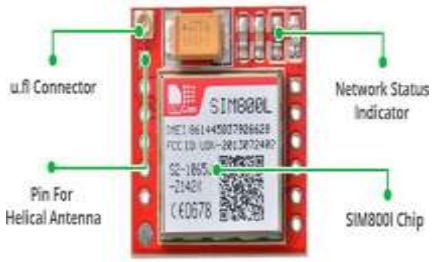


Fig.7. GSM SIM 800L

All data pins required for the SIM800L GSM chip are divided into 0.1 pitch headers. This contains the pins needed to communicate with the microcontroller via UART. This model supports baud rate from 1200bps to 115200bps and has automatic baud rate indicator.

6.4.GPS Neo 6M:

It is a complete GPS module based on Ublox Neo 6M. This model uses Ublox's latest technology to provide the best location information. It also includes an external GPS antenna and a UART TTL connector. This mod has a built-in lithium-ion rechargeable battery, so the mod can be hot-started and get GPS unlock faster in most situations. The UBlox NEO 6M GPS module engine is very good and has very accurate binary output. Due to its sensitivity, it is also suitable for indoor use.

Fig.8. GSP Neo 6M

The built-in battery also allows settings to be stored in EEPROM. This module has a UFL connector to connect the GPS antenna using a cable. It allows flexible mounting of the GPS module and ensures that the antenna is always pointed towards the sky for optimum visibility. Therefore, it is ideal for use in cars and other mobile GPS applications.

VII. Software Description

Arduino IDE (Integrated Development Environment) is used to write computer code and send the code to the physical board. Arduino IDE is very simple and this simplicity is one of the main reasons why Arduino is so popular. It works on Mac, Windows and Linux. Teachers and students use it to create low-energy devices, prove concepts in chemistry and physics, or start learning programming and robotics [21]. Arduino boards combined with sensors, actuators, and wireless connections allow homeowners to easily control every aspect of their living space. Different uses of Arduino in home automation systems include lighting and temperature control, automatic security systems, and energy management..

VIII. Result and Discussion

Initially, we developed a model to predict the process of the entire process, which can be done as part of research and development in the future. After completing all the work, we come up with a beautiful idea as in the picture. Once installed, the system went through months of testing to ensure all work was completed promptly. The accuracy of fault detection can be increased using three methods and lighting can be turned on and off, which saves energy. In the picture above, the first light went out due to a malfunction. At this time, the red LED will start to light. The lighting will not work when fully activated[22]. For testing purposes we use simple LEDs instead of lamps. GPS transmits the location of the refracted light. The indicator shows the address. If there are many lamps in one place, you can detect damaged lamps with the help of the red LED.

IX. Advantages

- Energy efficiency
- a Security
- Cost savings
- Data Analyzes

X. Future scope

- Smart City Integration
- Wireless Integration
- Predictive Maintenance
- Autonomous Management
- Energy Harvesting

XI. Sustainability

- Energy efficiency
- Conservation of resources
- Public Safety and Welfare
- Data-driven decision making
- Reduce light pollution

XII. Applications

- The system is designed to provide remote access to street lighting through a server to access the lighting system.
- This power can be transferred to different parts of the load to reduce the load problem. Conclusion GSM based automatic street lighting control system is based on light usage and speed.

XIII. Advantages

1. It is easy for line workers to detect the fault area.
2. This will help restore services faster in rural and urban areas.
3. Use IoT to control data loss and location.
4. Smaller products and less analysis.
5. Commercial, reliable and low cost.
6. The device can be used with wireless communication.

XIV. CONCLUSION

Resources (water, electricity, wind, etc.) are very valuable today. This project focuses on saving a single resource, energy. Electricity is one of the main energy sources. Automatic lighting and alarm systems with automatic on/off features are solutions that can help cities increase the efficiency and effectiveness of lighting maintenance. LDR sensor detects the change in the environment and automatically controls the street light turning on and off. When a lamp breaks or does not work at night, the LDR sensor detects this and sends a fault notification (using GPS) with the location of the broken lamp to authorized personnel. It reduces human effort and delays problem solving. Automatic lighting control is used to find the correct position when the lightings are damaged. It can also be used in all street lighting in rural lighting. First, identify damaged lamps according to their operating life. The system will provide many benefits over time, such as reducing illumination, increasing security, reducing energy consumption and costs, and better lighting maintenance.

XV. REFERENCES

[1] Prashanth. S U et al, "IoT Based Smart Street Lighting System," International Journal of Engineering Research & Technology (IJERT), Volume 10, No. 08, 2022

[2] D.K. Saini et al, "Auto Streetlight Control with Detecting Vehicle Movement," Advances in Energy Technology, Springer, Singapore, pp. 279-288, 2022

[3] N. Sravani et al., "Street Light Controlling and Monitoring of Fault Detection using LoRa," International Journal for Modern Trends in Science and Technology, vol. 7, no. 12, pp. 242-245, 2021.

[4] Ashok Kumar Nanduri et al, "IoT based Automatic Damaged Street Light Fault Detection Management System," (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 11, No. 8, 2020.

[5] C. Subramani et al., "Energy Efficiency and Pay-Back Calculation on Street Lighting Systems," The 11th National Conference on Mathematical Techniques and Applications, AIP Conf. Proc., vol. 2310, no. 1, 2019. [6] G.PRAVEEN et al , "National Highway Street Light Faulty Detection & Monitoring System," Journal of Emerging Technologies and Innovative Research (JETIR), Volume 6, No. 4, April 2019.

[7] Abdul Latif Saleem et al., "Street Light Monitoring and Control System," International Journal of Engineering and Techniques, vol. 1, no. 2, pp. 242-245, 2015.

[8] V. Sumathi et al., "Arm Based Street Lighting System with Fault Detection," International Journal of Engineering and Technology, vol. 5, no. 5, pp. 3423-3427, 2013

[9] K.Y. Rajput et al., "Intelligent Street Lighting System Using Gsm," International Journal of Engineering Science Invention, vol. 2, no. 3, pp. 32-35, 2013.

[10] Mr. AmeyJ.Manekar, Dr. Dr. R .V. Kshirsagar " Design and Implementation of Automatic Street Light Controller for Energy Optimization Using FPGA", International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 6, June 2016.

[11] Chaitanya Amin, AshutoshNerkar, ParidhiHolani, Rahul Kaul "GSM Based Autonomous Street Illumination System for Efficient Power Management" International Journal of Engineering Trends and TechnologyVolume4Issue1- 2013.

[12] Saifuzzaman, M., Nur, F.N., Moon, N.N., and Khan, A.H. (2017). "Smart Security for an Organization based on IoT", International Journal of Computer Applications 165(10), 33-38.

[13] SayaliArkade, AkshadaMohite, Rutuj, Vikas, "IoT Based Street Lights For Smart City" International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 4 Issue XII, December 2016.

[14] B.Abinaya, S.GuruPriya, "IOT BASED SMART AND ADAPTIVE LIGHTING IN STREET LIGHTING" Department of Information Technology Sri Sairam Engineering College.

[15] Sindhu.A.M, Jerin George, Sumit Roy, Chandra J, "Smart Streetlight Using IR Sensors" IOSR Journal of Mobile Computing & Application (IOSR-JMCA) e-ISSN: 2394- 0050, P-ISSN: 2394-0042.Volume 3, Issue 2.

[16] Vaishali Gupta, Krutika Thakur, Ritesh Thakur, "Based Smart Street Lights" International Journal of Research (IJR), Volume 2, Issue 10, October.

[17] Dhingra, V. & Cho, S. K. (2008). "Street Lighting Control Based on Lon Works Power Line Communication," IEEE In- ternational Symposium on Power Line Communications and Its Applications, Jeju City, 2-4 April 2008, pp. 396- 398.

[18] AmeyManekar, J., Dr. Kshirsagar, Dr. R .V. (2016). " Design and Implementation of Automatic Street Light Controller for Energy Optimization Using FPGA", International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 6, June 2016.

[19] Paridhi, Holani., Chaitanya, Amin., Rahul, Kaul., and Ashutosh, Nerkar. (2013). "GSM Based Autonomous Street Illumination System for Efficient Power Management" International Journal of Engineering Trends and Technology- Volume4Issue1.

[20] SachinDatta, N S., Abdul Latif Saleem., Sachin, H S., Raja Sagar, R., and Usha, M, S. (2015) "Street Light Monitoring and Control System" International Journal of Engineering and Techniques - Volume 1 Issue2.

[21] Monica, Pujari., Rajput, K,Y., Priyanka, Yadav., and Gargeyee, Khatav. (2013) " Intelligent Street Lighting System Using Gsm" International Journal of Engineering Science Invention Volume 2 Issue 3.

[22] Tarun Kumar, B., Sumathi, V., and Krishna Sandeep, A., (2013) "Arm Based Street Lighting System with Fault Detection" International Journal of Engineering and Technology- Vol 5 No 5 Oct-Nov 2013.